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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The single-particle mixing state and cloud scavenging of black carbon at a high-altitude mountain site in southern China" *by* Guohua Zhang et al.

Anonymous Referee #1

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This paper discusses the activation of black carbon (BC) containing particles into cloud droplets at a high altitude location. The authors collected cloud-interstitial aerosol (INT), residual aerosol from dried cloud droplets (RES), and aerosol during cloud-free periods. The impact of particle composition and size were then evaluated in regards to the aerosol's ability to activate into a cloud droplet. The largest particles and those with the highest fractions of secondary components, such as sulfate, had the highest activation fractions. However, the relative impacts of these two conditions (size v. composition) on the ability of the particles to be scavenged by the cloud are difficult to distinguish, as the largest particles also contained the highest fractions of secondary components. In addition, two different notations are used to describe the fractions

of BC and BC-containing particles in cloud droplets: activation of particles and cloud scavenging. Choosing one of these notations (activation or scavenging) and then evaluating for both number concentrations and BC mass fraction would help streamline the presentation of the results.

Specific Comments:

Line 163: Of the 7 wavelengths measured, why was 880 nm chosen to use for values of EBC?

Line 182: For the category of BC-sul1, should this line read "...and less sulfate" or is the sulfate concentration also high for this category? Also, how were the categories determined, i.e. what was the cut-point for categorizing a particle as "more intense sulfate" and "abundance of both sulfate and organics"? Was a specific mass-fraction used to divide the categories?

Line 204: Is ~0.1% the percentage of BC-containing particles detected only during the 2 hr window or for the whole sampling period for RES?

Line 259: Please clarify what is the meaning of "cannot be ruled out by" in this context and how this relates to the results presented.

Line 297: Please clarify how the particles at 700 nm decreased in size to 100 nm for the higher LWC. Is the decrease in size for the diameter of the activated droplets?

Line 309: The paragraph starting at line 309 deals solely with the role of mixing state in activation of BC-containing particles. This paragraph would fit more logically in "Section 3.1 Mixing state of BC for cloud-free, residual, and interstitial particles" than in its current location, "Section 3.2.1 – Size-resolved activation of BC-containing particles."

Line 318: The statement that organic-dominated particle types were "activated to a lesser extent" does not seem to be supported by Figure S9. For half of the diameters marked, the organic-dominant particles were nearly equal to or above the activated fraction of BC-containing particles. For the highest 3 diameters marked for the organic-

dominant particles, the error bars encompass the range of the BC-containing particles.

Line 322: Is this information (frequency of observation) included in one of the figures (possible figure 3)? If so, please include a reference here to the appropriate figure.

Line 370: Was LWC measured in this study? If not, why is the assumption made that the conditions are low-LWC?

Figure 1: Please add units for the vertical-axis categories. Also, are the PM2.5, EBC, and Num. of BC data for all categories (INT,RES, and cloud-free combined)?

Supplement Line 59: Please clarify what is meant by "they were taken into account" and how this relates to the calculation of the uncertainties that resulted in 10%.

Figure S8: Please clarify in the caption the line: "the other particles also contained OC particles ($\sim$10%)." Does 10% refer to the percent of total particles containing any amount of OC or the percent of total particles that had OC as the dominant species?

Technical Corrections:

Lines 336-337: Please divide these lines into two sentences: ". . ...areas (Huang et al., 2012). It is similar to those. . ..."

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